SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Bachelor of Engineering in Mechatronics Engineering (Hons.).

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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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AUTOMATED FRUIT GRADING SYSTEM

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Thesis submitted in fulfillment of the requirements
for the award of the Bachelor of
Mechatronics Engineering (Hons.)

Faculty of Manufacturing Engineering

UNIVERSITI MALAYSIA PAHANG

JUNE 2017

ACKNOWLEDGEMENTS

I would like to express my appreciation and sincere gratitude to my thesis's supervisor, Dr. Mohammed Abdo Hashem. Without his patient supervision, encouragement and invaluable guidance, this work could have never been accomplished. It has been a pleasure to work under his supervision.

I would like to express my sincere gratitude to my family for their patience, a loving and encouragement, which deserve much more attention that I could devote to them during this study as my family member whose blessings and support always helped me to face the challenges ahead. Without their encouragement and support, this work could not be accomplish.

At the end I would like to express my sincere thanks to all my friends and others who helped me directly or indirectly during this project.

ABSTRAK

Dalam kebelakangan ini, automatik teknologi pemeriksaan visual telah menjadi lebih berpotensi dan penting kepada banyak bidang. Ia adalah kerana kualiti buah-buahan menjadi faktor penting bagi pengguna dan adalah penting untuk seragam pemasaran hasil yang berkualiti tinggi. Kilang buah-buahan penggredan telah ditubuhkan untuk mengurangkan kos pengeluaran dan meningkatkan kualiti buah-buahan. Di samping itu, sistem pemeriksaan visual automatik bertujuan untuk menggantikan teknik manual untuk penggredan buah-buahan sebagai pemeriksaan manual menghadapi masalah dalam mengekalkan konsisten dan keseragaman. Projek ini menerangkan reka bentuk sistem buah penggredan automatik. Satu prototaip sistem ini direka dan diuji. Dalam projek ini, pengesanan kecacatan permukaan buah-buahan yang dinyatakan secara terperinci. Sistem dibangunkan bermula proses dengan menangkap imej buah-buahan dengan menggunakan kamera di mana buah-buahan yang diletakkan di atas meja yang berputar. Kemudian, imej yang dihantar kepada tahap pemprosesan di mana penggredan dilakukan dengan menggunakan MATLAB. Buah-buahan yang digredkan berdasarkan kecacatan permukaan mereka.

ABSTRACT

In recent years, automatic visual inspection technology has become more potential and important to many areas. It is because the quality of fruits becoming an important factor for the consumer and is essential for marketing uniform high quality produce. The fruits grading factories have been set up to reduce production costs and improve fruit quality. Besides, an automatic visual inspection system aimed to replace the manual technique for grading of fruits as manual inspection faces problems in maintaining consistency and uniformity. This project describes the design of an automated fruit grading system. A prototype of the system is designed and tested. In this project, the detection of surface defect of fruits is described in details. The developed system starts the process by capturing the fruit's image using camera where the fruits are placed on a rotating desk. Then, the image is transmitted to the processing level where the grading is done using MATLAB. The fruits are graded based on their surface defects.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The quality of the fruits is important for the consumers and become the requirement from the suppliers to provide fruits with high standards of quality. So, in the past few years, fruit grading systems had established to fulfil the needs of the fruit processing industry. Besides that, the process of fruits involves several steps that can generally be classified into grading, sorting, packaging, transporting and storage. The grading is considered as the most important steps towards the high standard of quality.

Fruits are almost graded manually which is an expensive and time consuming process and labours shortage will affect to the operation during peak seasons. It has become increasingly difficult to hire or train the person who are willing to handle the monotonous task of inspection. In the meanwhile, a cost effective and accurate grading can be performed with automated grading system.

Generally, the fruits quality depends on outer parameters (size, colour intensity, shape, surface appearances) and inner parameters (sugar contents, acid contents) but colour and size is the most important factor for grading and sorting of fruits. Nowadays, the fruit grading system based on weight, colour and size are accessible in the fruit processing industries.

The fruit grading system techniques using computer machine vision and image processing play the important role of quality control in fruit processing industries. From the past few years, different techniques have been enhanced to sort and evaluate the quality of fruits. These methods can help to detect different physical properties of fruits and with certain quality factors.

For example, the vision- based systems include CCD or CMOS sensors that are used to estimate the size and shape of fruits. It helps to predict the size of the fruits from its RGB image frame with the help of CCD camera. Software plays an important role in this colour classification system. The software system is almost designed in MATLAB to detect the colour and size of the fruits. Colour is very important in the sorting of fruits but due to the similarity of colours between some fruits, the size also helps in solving the problems.

1.2 Problem Statement

Fruits are the important roots of energy and nutrients for human body. With an embossed consumption, the quality of fruits is becoming extremely important for the food processing industries. The inspection of defects of the fruits is an important procedure to grade the fruits. This procedure is labour intensive and subject to human error. Hence, an automated grading system is necessary for inspection of fruits. In order to produce the fruit grading system, many factors that should be considered. To prevent any mis-gradation, the types of fruit are chosen based on the colour of the outer surface, such as mango and apple, so that the camera can detect the colour of the surface clearly. Thus, only two types of fruits are included in this project which are namely mango and apple.

Another problem statement in this project is some researchers use more than one camera for grading of rotationally symmetric product which costs a lot so we are trying in this project to use one camera with rotating of the fruits.

1.3 Objectives

The objectives of the study are:

1. To grade the fruits (apple and mango) based on their outside surface area either to have defect or not.
2. To apply automatic visual inspection system for the detection of fruit defects (apple and mango).
3. To build a low cost visual inspection system for fruit decay finding.

1.4 Scope

In this project, we will only concern on two types of fruits which are an apple and mango. The inspection will be accomplished from only the lateral surface of fruits. Besides, we use only one camera for inspection, therefore a certain area of the fruits can't be detected well which are the upper and lower sides. The fruits are put manually onto the area of inspection. Furthermore, two to three classification of fruits will be considered in this project. The entire system is designed using MATLAB software.

1.5 Project Methodology

The project involves the following activities:

i. Literature review

15 journals regarding the topic was reviewed. From the journals reviewed, there are many methods to grade the fruits. Image processing is the most important method that is used to capture the image of the fruits by using camera. Then, the inspection of fruits are done by detecting the surface of fruits. Lastly, classification of fruits is achieved.

ii Problem Statement

Some problems related to the grading of fruits are listed out. To prevent any mis-gradation, the types of fruit are chosen based on the colour of the outer surface, such as mango and apple, so that the camera can detect the colour of the surface clearly. Thus, only two types of fruits are included in this project which are namely mango and apple. Another problem statement in this project is some researchers use more than one camera for grading of rotationally symmetric product which costs a lot so we are trying in this project to use one camera with rotating of the fruits.

iii Objective

The first objective of the project is to grade the fruits such as apple and mango based on their surface area either to have defects or not. Next objective is to apply automatic visual inspection system for the detection of fruit defects (apple and mango) and lastly is to build a low cost visual inspection system for fruit decay finding.

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